(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 268 439 B2

(12) NEW EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the opposition decision:
28.10.1998 Bulletin 1998/44

(45) Mention of the grant of the patent:
10.04.1991 Bulletin 1991/15

(21) Application number: 87310060.6

(22) Date of filing: 13.11.1987

(51) Int Cl.6: H04N 1/028, G06K 9/03

COPY

(54) Image reading apparatus

Bildlesevorrichtung

Dispositif de lecture d'images

(84) Designated Contracting States:
DE FR GB IT NL

(30) Priority: 14.11.1986 JP 269842/86
14.11.1986 JP 269843/86

(43) Date of publication of application:
25.05.1988 Bulletin 1988/21

(73) Proprietor: CANON KABUSHIKI KAISHA
Tokyo (JP)

(72) Inventors:
- Suda, Kenichi
Yokohama-shi Kanagawa-ken (JP)
- Hasegawa, Shizuo
Meguro-ku Tokyo (JP)
- Matsuoka, Nobuo
Yokohama-shi Kanagawa-ken (JP)

(74) Representative:
Beresford, Keith Denis Lewis et al
BERESFORD & Co.
2-5 Warwick Court
High Holborn
London WC1R 5DJ (GB)

(56) References cited:
EP-A- 0 169 411
EP-A- 0 233 990
AT-B- 377 862
DE-A- 2 915 398
DE-A- 3 014 629
GB-A- 2 154 827
GB-A- 2 156 628
GB-A- 2 163 620
US-A- 3 800 078
US-A- 3 952 144

Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image reading apparatus for photoelectrically reading an image using an image sensor.

Related Background Art

A demand has arisen for developing a high-resolution, compact, color image reading apparatus which reads image data from a document carrying the image data. As a technique for meeting such a demand, as proposed in U.S. Patent Application Serial Nos. 724,300 (filed on April 7, 1985, published under nr.: US-A-4 667 227), and 544,240 (filed on October 21, 1983, published under nr.: US-A-4 679 073) by the present applicant, a solid state scan technique is known. More specifically, an apparatus using a combination of a photodiode array and a MOS switch, or using a semiconductor function element having both a pixel separation function and an optical data storage function, is known. Such a solid-state imaging element is highly miniaturized. Therefore, the size of one chip is much smaller than that of a document. For this reason, a reduction optical system must be used between a document surface and the element.

Contrary to this, when an optical system performing a focusing operation having one-to-one correspondence, such as a focusing optical transmission array in which a large number of focusing optical fibers are aligned in arrays, is used, an apparatus does not become large in size unlike the case wherein the reduction optical system is used. However, in consideration of color balance or assurance of gray scale levels, a linear light receiving element array must be used over the total width of a document.

For this reason, in recent years, studies on development of a contact sensor have been made. The present applicant proposed an image reading apparatus using the contact sensor in U.S. Patent Application Serial Nos. 023,968 (filed on May 10, 1987 published under nr.:US-A-4 734 787), 704,920 (filed on February 25, 1985 published under nr.: US-A-4 691 114). In an arrangement using the contact sensor, since the reduction optical system need not be used, the apparatus can be rendered compact. However, it is difficult to prepare an elongate sensor capable of covering the total width of a document. Therefore, a plurality of line sensors are arranged in a line or in a staggered manner.

Therefore, signals separately read by a plurality of lines of line sensors must be linked to obtain a continuous signal for a line. In this case, if the characteristics of the line sensors or the characteristics of processing circuits corresponding to the line sensors are not uniform, a good image output cannot be obtained.

SUMMARY OF THE INVENTION :

The present invention has been made in consideration of the above situation and has as its object to provide an image reading apparatus capable of obtaining a good image signal output when a document image is read by a plurality of line sensor.

It is another object of the present invention to provide an image reading apparatus capable of obtaining an image signal having a high black level in an arrangement wherein a document image is read by a plurality of line sensors.

It is still another object of the present invention to provide an image reading apparatus suitable for reading a color document.

It is still another object of the present invention to provide an image reading apparatus capable of outputting a good image signal with respect to both black and white images.

The above and other objects and effects of the present invention will be apparent from the claims and from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS :

Fig. 1 is a side view showing an arrangement of an optical system and a sensor unit used in an embodiment of the present invention;

Fig. 2 is a perspective view showing a mechanical arrangement of the sensor unit;

Fig. 3 is a view for explaining a pixel arrangement of the sensor unit;

Fig. 4 is a view for explaining a CCD chip arrangement in the sensor unit used in this embodiment;

Fig. 5 is a view for explaining a pixel arrangement in a CCD chip;

Fig. 6 is a block diagram showing an arrangement of a signal processing unit in the embodiment of the present invention;

Fig. 7 is a block diagram showing a detailed arrangement of the signal processing unit shown in Fig. 6;

Fig. 8 is a circuit diagram showing a detailed arrangement of a clamp circuit for performing black correction in the processing unit shown in Fig. 7;

Fig. 9 is a view for explaining black and white correction operations in this embodiment;

Fig. 10 is a flow chart showing a processing sequence of black correction in this embodiment;

Fig. 11 is a circuit diagram showing a detailed arrangement of a multiplier for performing white correction in the processing unit shown in Fig. 7; and

Fig. 12 is a view showing an arrangement of an image reading apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT:

An embodiment of the present invention will be described with reference to the accompanying drawings.

Fig. 12 shows an arrangement of an image reading apparatus 100 to which the present invention is applied.

In Fig. 12, the apparatus 100 includes a transparent document glass table 122 for placing a document 121 thereon, a document cover 123, a light source 124 for exposing the document 121, a reflection shade 125 for efficiently providing an amount of light of the light source 124, a focusing optical transmission array 126 for guiding light reflected by the document 121, and a sensor unit 127 for converting an optical image focused by the array 126 into an electrical signal. In addition, the apparatus 100 includes a reciprocal sensor fixing table 128 for fixing the light source 124, the reflection shade 125, the array 126, and the sensor unit 127, a shaft 129 for holding the sensor fixing table 128, a fixing table 130 for supporting the shaft 129, a wire 131 for transmitting a reciprocating force to the sensor fixing table 128, a roller 132 for transmitting a drive force of the wire 131, a drive roller 133, fixed to a rotational drive source, for fixing the wire 131, a drive wire 134 connecting a drive source and the drive roller 133, a motor 135 as a drive source, and a cable 136 for guiding an output from the sensor unit 127.

The apparatus 100 further includes a control processing unit 137 for controlling the output from the sensor unit 127, and the operation of the light source 124 and the motor 135. Moreover, the apparatus 100 includes a forward limit switch 138 operated by the sensor fixing table 128, a home position sensor 139 for the sensor fixing table 128, and an operation panel 140 which is used by an operator to input a copy instruction and the like.

An operation of the image reading apparatus will be described. When a copy instruction is input from the operation panel 140, the control processing unit 137 outputs a signal for turning on the light source 124. The light source 124 is turned on in response to this signal. Then, the motor 135 is rotated in a normal direction. The sensor fixing table 128 begins to move forward in a direction indicated by an arrow A. Thus, the document 121 is read for each line by the sensor unit 127 which is moved in a sub-scan direction. Then, the optical line image read by the sensor unit 127 is converted into an electrical signal. The fixing table 128 which has reached an end point of reciprocal movement operates the forward limit switch 138, thereby causing the motor 135 to rotate in a reverse direction. Thus, the fixing table 128 begins to move backward. Then, the home position sensor 139 is operated to stop the motor 135, and the sensor fixing table 128 is stopped at the home position.

Fig. 1 shows an arrangement of an optical system used in the image reading apparatus of this embodiment. In Fig. 1, the optical system includes a halogen lamp 12 serving as the light source, a reflection shade 13 for focusing a light beam onto a document glass 11, a focusing optical transmission array 14 which is arranged at a position receiving light focused on a document surface and reflected thereby, and at which the document surface is located at a focal point on an incident side, and a sensor unit 15 having CCDs. The sensor unit 15 is arranged at a focal point opposite to that of the array 14, so that an erect image having one-to-one correspondence with a document image is focused on a CCD chip of the sensor unit 15. Black and white plates 16 and 17 serving as references in black and white correction operations (to be described later) are arranged outside, e.g., a placing range of a document.

Fig. 2 shows an arrangement of the sensor unit 15. The sensor unit 15 used in this embodiment has a ceramic circuit board 26 on which five CCD chips 21 to 25 are arranged in a staggered manner, a glass cover 27 for covering the ceramic circuit board 26, and connecting lead wires 28.

Fig. 3 shows an arrangement of pixels of the CCD chip in the sensor unit 15. The CCD chip comprises a line sensor in which a light receiving portion having a total of 3168 pixels, i.e., dummy pixels D1 to D12, optical shield pixels D13 to D36 shielded by aluminum (Al) or the like, dummy pixels D37 to D72, effective signal pixels S1 to S3072, and rear-end dummy pixels D73 to D96 are aligned in an array. In this embodiment, as described above, the CCD chips 21 to 25 are aligned in two arrays in a staggered manner. The two arrays of the CCD chips are arranged parallel to each other to have a central distance ℓ of the light receiving portions. Upon arrangement, the CCD chips overlap so that the effective signal pixels S1 to S3072 of the adjacent chips are continued to define a total effective read width of 304 mm by the CCD chips 21 to 25.

In this embodiment, the distance ℓ corresponds to four pixels. Therefore, images to be focused on the adjacent CCD chips are separated by four lines with respect to a document surface. In order to adjust this, memories are provided to the CCD chips 21 to 25. Fig. 5 shows the arrangement of the CCD chips 21 to 25. In Fig. 5, each CCD chip includes light receiving portions 51 as photosensitive pixels, and an Al shield portion 52. Each light receiving portion 51 comprises a silicon (Si) photodiode, and has a size of 62.5 μm $\times$ 15.5 μm, as shown in Fig. 5.

A color filter is directly deposited on each Si element. Green (G), blue (B), and red (R) color filters are repetitively arranged, and one pixel in a read mode is constituted by 3 bits.

Fig. 6 shows an arrangement of a signal processing unit in the image reading apparatus according to this embodiment. B, G, and R pixel outputs from each of the CCD chips 21 to 25 are output as a composite signal. The composite signal from each CCD chip is first input to an analog signal processing circuit unit 61 to be separated into B, G, and R signals. The respective color

signals are subjected to gain and level control, and are then A/D converted into 8-bit digital signals. The analog signal processing circuit unit 61 comprises analog signal processing circuits 61a to 61e receiving image signals from the CCD chips 21 to 25, respectively. Each circuit has an independent circuit arrangement.

A memory unit 62 is adopted to link image signals in the effective image width of 304 mm for each color of the digital image signal so that the pixels of the effective image width are not disconnected and do not overlap each other. The memory unit 62 includes memories 62a, 62b, and 62c for respectively storing B, G, and R image signals.

The image signals which are linked in line for each color by the memory unit 62 are subjected to logarithmic conversion by a table developed in a ROM 63 to be converted into yellow (Y), magenta (M), and cyan (C) color density signals from the B, G, and R optical signals. The converted data are input to a white balance circuit unit 64. Thus, variations in sensitivity and amount of light of pixels of the CCD chips 21 to 25 are corrected by the circuit unit 64. The circuit unit 64 includes white balance circuits 64a, 64b, and 64c for independently correcting the Y, M, and C signals. Image signals are supplied from the white balance circuits 64a to 64c to a CPU 65, so that correction data subjected to black and white correction operations are fed back from the CPU 65 to the analog signal processing circuit unit 61, as will be described later with reference to Fig. 10. The CPU 65 includes a ROM 65 storing a program corresponding to the processing sequence shown in Fig. 10, and a RAM 65b having work areas.

Fig. 7 shows a detailed arrangement of the signal processing unit shown in Fig. 6. A signal processing operation of one CCD chip will be described with reference to Fig. 7. Note that Fig. 7 illustrates a circuit arrangement for a color signal B. Similar circuit arrangements can be adopted for color signals G and R.

The composite image signal output from the sensor unit 15 is amplified by a variable amplifier 71, and is then separated into each of B, G, and R image signals by a sample/hold circuit 72.

The separated signal is amplified by a variable amplifier 73, and is input to an 8-bit A/D converter 76 through a multiplier 74. The multiplier 74 will be described later in detail. During signal level control, the multiplier 74 serves as an amplifier having a fixed gain. An upper level of the input level to the A/D converter 76 is adjusted by the variable amplifiers 71 and 73 using an image signal obtained when the sensor unit 15 reads the reference white plate 17. The input signal to the A/D converter 76 is fed back to the input terminal of the variable amplifier 73 through a clamp circuit 75 which clamps data using an output corresponding to the optical shield pixels described with reference to Fig. 3. A bias level is added to the clamp level, so that the lower level of the input to the A/D converter 76 is adjusted using an image signal obtained when the sensor unit 15 reads the reference black plate 16.

8-bit digital image signals from the A/D converter 76 are linked by the memory 62 of the corresponding color, so that the signals from the five CCD chips 21 to 25 are linked in line, as has been described with reference to Fig. 6. Thus, independent image signals are reconstructed as one image signal.

In this manner, the image signal reconstructed by the memory 62 is subjected to logarithmic conversion by the ROM 63, and is converted to a signal representing a color density.

The image signal is corrected by the white balance circuit 64 including a RAM 77, an inverter 78, and an adder 79 based on a signal when the sensor unit 15 reads the reference white plate 17 as described above.

The above operation is performed for three colors, i.e., B, G, and R, and for the CCD chips 21 to 25. Note that the CPU 65 time-serially controls the respective signal processing units.

As described above, the analog signal processing circuit unit 61 according to this embodiment has independent circuit arrangements for the five CCD chips 21 to 25. Therefore, it is difficult to strictly perform level control among the CCD chips in the image signal reconstruted in line. Due to independent circuit systems, if different drifts occur in circuits, a means for correcting them is necessary. For this reason, in this embodiment, black and white correction operations are performed.

The black correction is performed by the clamp circuit 75 shown in Fig. 7.

Fig. 8 shows a detailed arrangement of the clamp circuit 75. The clamp circuit 75 according to this embodiment comprises a clamp circuit 81 for clamping an optical shield pixel output of the CCD chip at 0 V, a multiplier type D/A converter 82 receiving a voltage V_1 output from a constant voltage power supply 85 and capable of controlling an output by 8-bit digital data, a current-voltage conversion amplifier 83, and an operational amplifier 84.

Therefore, an output from the amplifier 83 is determined by 8-bit digital input values DO to D7 of the D/A converter 82, and the relationship between the input voltage V_1 and an output voltage V2 is as follows:

$$V_2 = V_1 \times D/255 (D\text{: digital input value})$$

Therefore, a bias level added to the clamp level of a signal from the operational amplifier 84 can be controlled by the 8-bit digital data DO to D7 from the CPU 65.

When the black correction is performed, the digital values input to the D/A converter 82 are set to be a given constant, and an image signal obtained when the sensor unit 15 reads the reference black plate 16 is fetched from the RAM 77 to the CPU 65.

Fig. 9 shows a level of the one-line image signal obtained in this manner. In Fig. 9, image signals 91 to

95 are obtained when the CCD chips 21 to 25 read the black plate 16.

Since the CCD chips 21 to 25 have different sensitivities, the levels of the signals therefrom vary, as shown in Fig. 9. In order to correct the variation and improve gray scale levels, each level obtained when the black plate 16 is read is calculated by the CPU 65 to be the mimimum level of the output from the A/D converter 76, i.e., 00H, and the corresponding correction value is fed back to each D/A converter 82 using the data DO to D7 with respect to the processing circuits of the CCD chips 21 to 25.

Fig. 10 shows the processing sequence executed by the CPU 65 during the black correction.

At the beginning of the processing, in an apparatus in which an optical system is moved with respect to a document, the optical system is located below the black plate 16. In step S1, the lamp 12 is turned on, and in step S2, the apparatus stands by using a timer until an amount of light of the lamp 12 is stabilized.

In step S3, data developed in the RAM 77 and obtained by reading the black plate 16 by the CCD chips 21 to 25 are fetched in the CPU 65. It is checked in step S4 if "00H" is present in one-line data. If N (NO) in step S4, the flow advances to step S5, and inverse logarithms of the data are calculated to recover data before logarithmic conversion by the ROM 63. In step S6, a correction value for aligning boundary data of the adjacent CCD chips is calculated. In step S7, the correction value is added to data set to be digital input values to the D/A converter 82 corresponding to each CCD chip, thus resetting the data.

After a predetermined period of time concerning an operation time of the circuits has been counted by a timer in step S8, the data in the RAM 77 are again fetched in the CPU 65.

In order to reduce the entire level to "00H" while the image signals are linked in one line, a minimum value Dmin of data in one line is calculated in step S10. In step S12, the value Dmin is subtracted from the digital input values to the D/A converter 82, thus resetting the data.

Meanwhile, if it is determined in step S4 that "00H" is present in the one-line data, this means that the input values DO to D7 initially set in the D/A converter 82 are too small. Therefore, in step S13, a constant K is added to the input values, which are again input to the D/A converter 82. After a predetermined period of time has passed in consideration of the operation time of the circuit in step S14, the flow returns to step S3, and the same operation in step S3 and subsequent steps is performed.

The above operation is performed for three colors, i.e., B, G, and R. Thus, the image signals obtained when the black plate 16 is read are linked in one line, and the one-line image signal can be approximated to minimum value "00H" of the image data.

The white correction is performed by the multiplier 74 shown in Fig. 7.

Fig. 11 shows a detailed arrangement of the multiplier 74. In Fig. 11, the multiplier 74 includes a multiplier type D/A converter 111 having 8-bit digital input terminals DD0 to DD7, and a current-voltage conversion amplifier 112.

First, digital values into the D/A converter 111 are set to be a given constant. Note that the image signal level when the sensor unit 15 reads the white plate 17, i.e., the input level to the A/D converter 76, is pre-adjusted by the variable amplifiers 71 and 73 so as not to exceed the maximum input level of the A/D converter and so as to be approximated thereto.

At this time, a one-line image signal is fetched from the RAM 77 in the CPU 65. Referring again to Fig. 9, image signals 96 to 100 are output form the CCD chips 21 to 25 when they read the white plate 17. Since the sensitivities of the CCD chip are different from each other or the circuit systems are independently arranged, the respective signals are not linearly linked. In order to correct this and to improve the gray scale levels of the apparatus, an image signal obtained when the sensor 15 read the white plate 17 is calculated by the CPU 65 to be approximated to the maximum value of the output from the A/D converter, i.e., "FFH", and independent correction values DD0 to DD7 are fed back to each D/A converter 111 with respect to the processing circuits of the CCD chips 21 to 25.

The white correction described above can be executed following the same procedures as in Fig. 10 for the black correction.

When the white correction described above is performed, even if an amount of light varies, the image signal obtained when the white plate 17 is read is fed back to be approximated to "FFH". Therefore, gradation of the image data will not be impaired.

In the above embodiment, in the sensor unit, the sensors are arranged in a staggered manner. However, the arrangement of the sensors may be changed. For example, the sensors can be linearly arranged.

According to the above embodiment as described above, the clamp level of the image signals from each sensor is individually corrected in accordance with the level of an image signal obtained when a black reference image such as a black plate is read. Therefore, the image signals can be linearly linked at a level when the black reference image is read, i.e., when the original density is high, thus obtaining a stable image signal.

The image signal at this time is caused to coincide with the lower input level of the A/D converter. Therefore, a wide range of gray scale levels can be reproduced.

A gain of an image signal of each sensor is individually corrected in accordance with an image signal level obtained when a white reference image, e.g., a white plate, is read. Thus, the image signals obtained when a white reference image is read can be linearly linked. If different drifts occur in independent processing circuits, they can be corrected.

Furthermore, the linearly linked image signals are always corrected to be an identical level. Even if an amount of light varies, identical gray scale levels can always be obtained without impairing gradation.

Claims

1. An image reading apparatus comprising:

   a plurality of line sensors (21-25) for reading an image of a document, each line sensor (21-25) comprising a linear array of sensor elements (S1-S3072) each of said line sensors (21-25) being arranged to read a different contiguous portion of a line of the document and arranged to output a corresponding line signal;

   characterised by:

   a plurality of level control means (75) each for applying a respective level offset to the line signal output by a respective one of said plurality of line sensors (21-25); and
   control means (65) for determining from the respective line signals, obtained by reading a black reference member (16) with said plurality of line sensors (21-25), differences in level at points corresponding to boundaries between line sensors (21-25), and, on the basis of those differences, controlling said level control means (75) to apply a single respective level offset to each respective line signal to align said line signals at points corresponding to said boundaries.

2. An apparatus according to claim 1, further comprising converting means (76) for converting signals from said plurality of level control means into digital signals.

3. An apparatus according to claim 1, wherein each of said plurality of line sensors is adapted to read a colour image of a document and adapted to generate a plurality of colour component signals.

4. An apparatus according to claim 1, wherein said control means has storing means (65) for storing the respective line signals obtained by reading the black reference member.

5. An apparatus according to claim 1, comprising a plurality of gain adjustment means (74) each for applying a respective adjustable gain amplification to the line signal output by each respective one of said plurality of line sensors.

6. An apparatus according to claim 5, wherein said plurality of gain adjustment means is arranged to perform gain adjustment on the basis of signals obtained by reading a white reference member using said plurality of line sensors.

7. An apparatus according to claim 3, for reading a colour image, which apparatus comprises:

   an image sensor (15) comprising said plurality of line sensors (21-25), each to output a respective line signal for a respective line portion of a reference member (16,17) or a document (121), each comprising a linear array of optically shielded sensor elements (D13-D36) and effective signal sensor elements (S1-S3072), the latter being covered by an array of colour filters having a three-colour recurrent sequence, said line sensors being arranged in a staggered manner in two rows such that said effective sensor elements (S1-S3072) extend across the reading width of said image sensor (15) without discontinuity and without overlap;
   analog signal processing circuits (61a-61e), one for each line sensor (21-25), each arranged to receive a respective line signal and having, for each colour, sample and hold means (72) for separating a respective colour signal from the respective line signal, level offset and gain adjustment means (73-75) to apply an adjustable signal level offset and an adjustable gain amplification to the respective colour signal, and an analog to digital converter (76), of predetermined dynamic range, to convert the respective colour signal output from said level offset and gain adjustment means (73-75) to digital data; and
   control means (62-65), responsive to said digital data, to determine and to control the level offset and gain applied by said level offset and gain adjustment means (73-75); wherein
   said apparatus includes a black reference member (16) and a white reference member (17) and is adapted to read the black reference member (16), the white reference member (17) and the document (121) in turn;
   each level offset and gain adjustment means (73-75) includes:

   i) clamp means (81,84) responsive to said optically shielded sensor elements (D13-D36) to apply a level offset to the respective colour signal;
   ii) level adjustment means (82-85), responsive to first control data (D0-D7) supplied by said control means (62-65), to supplement the level offset applied by said clamp means (81,84); and
   iii) multiplier means (74), responsive to

second control data (DDO-DD7) supplied by said control means (62-65), to change the signal gain of the respective colour signal offset by said clamp means (81,84) and level adjustment means (82-85); and

said control means (62-65) is adapted to execute sequential steps of:

(a) determining from values of the digital data, obtained when reading said black reference member (16) with said first and second control data (D0-D7, DD0-DD7) having initial set values, differences in signal level between the respective colour signals, for each respective colour, at points corresponding to last and first effective sensor elements (S3070,S1; S3071,S2; S3072,S3) of the respective colour, defining respective boundaries of said line sensors (21-25), and supplying first control data (D0-D7) of modified value to said level adjustment means (82-85), to apply a modified level offset to respective colour signals to equalise the signal levels at said points corresponding to said respective boundaries;
(b) determining from the values of digital data, obtained when reading said black reference member (16) with said first and second control data (D0-D7,DD0-DD7) having said modified value and initial value respectively, a respective minimum value (D min) for each respective colour, and supplying first control data (D0-D7) of revised value to said level adjustment means (82-85) to apply a revised level offset to respective colour signals so that they lie at or above the lower limit of the dynamic range of the respective analog to digital converters (76);
(c) determining from values of the digital data, obtained when reading said white reference member (17) with said first and second control data (D0-D7,DD0-DD7) having said revised value and initial value respectively, differences in signal level between the respective colour signals, for each respective colour, at said points, and supplying second control data (DD0-DD7) of modified value to said multiplier means (74), to apply a modified gain to respective colour signals to equalise the signal levels corresponding to said respective boundaries;
(d) determining from values of the digital data, obtained when reading said white reference member (17) with said first and second control data (D0-D7, DD0-DD7) having said revised values and modified values respectively, a respective maximum value, for each respective colour, and supplying respective second control data (DD0-DD7) of revised value to the respective multiplier means (74), to apply a revised gain to respective colour signals so that they lie at or below the upper limit of the dynamic range of the respective analog to digital converters (76); and
(e) supplying respective first and second control data (DO-D7, DD0-DD7) of said revised values, to the respective level adjustment means (75) and multipliers (74) for reading the document.

Patentansprüche

1. Bildlesevorrichtung mit

einer Vielzahl von Zeilensenoren (21 bis 25) zum Lesen eines Vorlagenbilds, wobei jeder Zeilensensor (21 bis 25) eine lineare regelmäßige Anordnung von Sensorelementen (S1 bis S3072) aufweist, jeder Zeilensensor (21 bis 25) zum Lesen eines unterschiedlichen durchgehenden Abschnitts einer Zeile der Vorlage und zur Ausgabe eines entsprechenden Zeilensignals eingerichtet ist,

gekennzeichnet durch

eine Vielzahl von Pegelsteuereinrichtungen (75) jeweils zum Beaufschlagen eines jeweiligen Pegelversatzes auf das durch einen jeweiligen Zeilensensor aus der Vielzahl der Zeilensensoren (21 bis 25) ausgegebene Zeilensignal, und
eine Steuereinrichtung (65) zur Bestimmung von Pegelunterschieden Punkten, die Begrenzungen zwischen den Zeilensensoren (21 bis 25) entsprechen, anhand der jeweiligen durch Lesen eines Schwarzreferenzteils (16) mittels der Vielzahl der Zeilensensoren (21 bis 25) erhaltenen Zeilensignale sowie zur Steuerung der Pegelsteuereinrichtung (75) auf der Grundlage dieser Unterschiede derart, daß ein einzelner jeweiliger Pegelversatz einem jeweiligen Zeilensignal beaufschlagt wird, damit die Zeilensignale an den Punkten ausgerichtet werden, die den Begrenzungen entsprechen.

2. Vorrichtung nach Anspruch 1,
gekennzeichnet durch
eine Wandlereinrichtung (76) zur Umwandlung von Signalen aus der Vielzahl der Pegelsteu-

ereinrichtungen in digitale Signale.

3. Vorrichtung nach Anspruch 1,
dadurch gekennzeichnet, daß
jeder Zeilensensor aus der Vielzahl der Zeilensensoren zum Lesen eines Farbbilds einer Vorlage sowie zur Erzeugung einer Vielzahl von Farbkomponentensignalen angepaßt ist.

4. Vorrichtung nach Anspruch 1,
dadurch gekennzeichnet, daß
die Steuereinrichtung eine Speichereinrichtung (65) zum Speichern der durch Lesen des Schwarzreferenzteils erhaltenen Zeilensignale aufweist.

5. Vorrichtung nach Anspruch 1,
gekennzeichnet durch
eine Vielzahl von Verstärkungseinstelleinrichtungen (75) jeweils zum Beaufschlagen einer jeweiligen einstellbaren Verstärkung auf das durch jeden jeweiligen Zeilensensor ausgegebene Zeilensignal.

6. Vorrichtung nach Anspruch 5,
dadurch gekennzeichnet, daß
die Vielzahl der Verstärkungseinstelleinrichtungen zur Durchführung einer Verstärkungseinstellung auf der Grundlage von Signalen eingerichtet ist, die durch Lesen eines Weißreferenzteils unter Verwendung der Vielzahl der Zeilensensoren erhalten werden.

7. Vorrichtung nach Anspruch 3 zum Lesen eines Farbbildes, mit

einem Bildsensor (15) mit der Vielzahl der Zeilensensoren (21 bis 25), die jeweils zur Ausgabe eines jeweiligen Zeilensignals für einen jeweiligen Zeilenabschnitt eines Referenzteils (16, 17) oder einer Vorlage (121) dienen und die jeweils eine lineare regelmäßige Anordnung optisch abgeschirmter Sensorelemente (D13 bis D36) und wirksamer Signalsensorelemente (S1 bis S3072) aufweisen, wobei die letzteren mit einer regelmäßigen Anordnung von Farbfiltern mit einer wiederkehrenden Folge aus drei Farben bedeckt sind und die Zeilensensoren in einer gestaffelten Weise in zwei Reihen derart angeordnet sind, daß die wirksamen Sensorelemente (S1 bis S3072) über die Lesebreite des Bildsensors (15) ohne Unterbrechung und ohne ein Überlappen verlaufen,
analogen Signalverarbeitungsschaltungen (61a bis 61e), von denen für jeden Zeilensensor (21 bis 25) eine vorgesehen ist, die jeweils zum Empfang eines jeweiligen Zeilensignals eingerichtet sind und für jede Farbe eine Abtast-/Halteschaltung (72) zum Trennen eines jeweiligen Farbsignals aus dem jeweiligen Zeilensignal, eine Pegelversatz- und Verstärkungseinstelleinrichtung (73 bis 75) zum Beaufschlagen eines einstellbaren Signalpegelversatzes und einer einstellbaren Verstärkung auf das jeweilige Farbsignal sowie einen Analog-Digitalwandler (76) eines vorbestimmten Dynamikbereichs zur Umwandlung des aus der Pegelversatz- und Verstärkungseinstelleinrichtung (73 bis 75) ausgegebenen Farbsignals in digitale Daten aufweist, und
auf die digitalen Daten ansprechenden Steuereinrichtungen (62 bis 65) zur Bestimmung und zur Steuerung des Pegelversatzes und der Verstärkung, die durch die Pegelversatz- und Verstärkungseinstelleinrichtung (73 bis 75) beaufschlagt werden, wobei
die Vorrichtung das Schwarzreferenzteil (16) und ein Weißreferenzteil (17) aufweist und nach angepaßt ist, das Schwarzreferenzteil (16), das Weißreferenzteil (17) und der Vorlage (121) der Reihe nach zu lesen,
jede Pegelversatz- und Verstärkungseinstelleinrichtung (73)

i) eine auf die optisch abgeschirmten Sensorelemente (D13 bis D36) ansprechende Klemmeinrichtung (81, 84) zum Beaufschlagen eines Pegelversatzes auf das jeweilige Farbsignal,
ii) eine auf die durch die Steuereinrichtung (62 bis 65) zugeführten ersten Steuerdaten (D0 bis D7) ansprechende Pegeleinstelleinrichtung (82 bis 85) zur Ergänzung zu dem durch die Klemmeinrichtung (81, 84) beaufschlagten Pegelversatz und
iii) eine auf die durch die Steuereinrichtung (62 bis 65) zugeführten zweiten Steuerdaten (DD0 bis DD7) ansprechende Multipliziereinrichtung (74) zur Veränderung der Signalverstärkung des jeweiligen Farbsignalversatzes durch die Klemmeinrichtung (81, 84) und die Pegeleinstelleinrichtung (82 bis 85) aufweist, sowie

die Steuereinrichtung (62 bis 65) zur Ausführung aufeinanderfolgender Schritte

(a) Bestimmen von Signalpegelunterschieden zwischen den jeweiligen Farbsignalen für jede jeweilige Farbe an Punkten entsprechend letzten und ersten wirksamen Sensorelementen (S3070, S1; S3071, S2; S3072, S3) der jeweiligen Farbe, die jeweilige Begrenzungen der Zeilensensoren (21 bis 25) abgrenzen, anhand von Werten der digitalen Daten, die beim Lesen des

Schwarzreferenzteils (16) mit den anfänglich eingestellte Werte aufweisenden ersten und zweiten Steuerdaten (D0 bis D7, DD0 bis DD7) erhalten werden, und Zuführen erster Steuerdaten (D0 bis D7) mit abgeändertem Wert zu der Pegeleinstelleinrichtung (82 bis 85) zum Beaufschlagen eines abgeändertem Pegelversatzes auf die jeweiligen Farbsignale, damit die Signalpegel an den Punkten ausgeglichen werden, die den jeweiligen Begrenzungen entsprechen,

(b) Bestimmen eines jeweiligen Minimalwerts (Dmin) für jede jeweilige Farbe anhand der Werte der digitalen Daten, die beim Lesen des Schwarzreferenzteils (16) mit den ersten und zweiten Steuerdaten (D0 bis D7, DD0 bis DD7) mit jeweils dem abgeänderten Wert und dem anfänglichen Wert erhalten werden, und Zuführen erster Steuerdaten (D0 bis D7) mit revidiertem Wert zu der Pegeleinstelleinrichtung (82 bis 85) zum Beaufschlagen eines revidierten Pegelversatzes auf die jeweiligen Farbsignale derart, daß diese auf oder über der unteren Grenze des dynamischen Bereichs der jeweiligen Analog-Digitalwandler (76) liegen,

(c) Bestimmen von Signalpegelunterschieden zwischen den jeweiligen Farbsignalen für jede jeweilige Farbe an den Punkten anhand von Werten der digitalen Daten, die beim Lesen des Weißreferenzteils (17) mit den jeweils den revidierten Wert und den anfänglich eingestellten Wert aufweisenden ersten und zweiten Steuerdaten (D0 bis D7, DD0 bis DD7) erhalten werden, und Zuführen der zweiten Steuerdaten (DD0 bis DD7) mit einem abgeändertem Wert zu der Multipliziereinrichtung (74) zum Beaufschlagen einer abgeänderten Verstärkung auf jeweilige Farbsignale, damit die Signalpegel entsprechend den jeweiligen Begrenzungen angeglichen werden,

(d) Bestimmen eines jeweiligen Maximalwerts für jede Farbe anhand von Werten der digitalen Daten, die beim Lesen des Weißreferenzteils (17) mit den jeweils die revidierten Werte und die abgeänderten Werte aufweisenden ersten und zweiten Steuerdaten (D0 bis D7, DD0 bis DD7) erhalten werden, und Zuführen jeweiliger zweiter Steuerdaten (DD0 bis DD7) mit revidiertem Wert zu den jeweiligen Multipliziereinrichtungen (74) zum Beaufschlagen einer revidierten Verstärkung auf die jeweiligen Farbsignale derart, daß sie auf oder unter der oberen Grenze des dynamischen Bereichs der jeweiligen Analog-Digitalwandler (76) liegen, und

(e) Zuführen jeweiliger erster und zweiter Steuerdaten (D0 bis D7, DD0 bis DD7) mit revidierten Werten zu den jeweiligen Pegeleinstelleinrichtungen (75) und Multiplizieren (74) zum Lesen der Vorlage eingerichtet ist.

Revendications

1. Appareil de lecture d'images, comportant :

   une pluralité de capteurs de lignes (21-25) destinés à lire une image d'un document, chaque capteur de ligne (21-25) comportant un réseau linéaire d'éléments capteurs (S1-S3072), chacun desdits capteurs de lignes (21-25) étant agencé de façon à lire une partie contiguë différente d'une ligne du document et étant agencé pour délivrer en sortie un signal de ligne correspondant ;

   caractérisé par :

   plusieurs moyens (75) de réglage de niveau destiné chacun à appliquer un décalage de niveau respectif au signal de ligne délivré en sortie par l'un, respectif, de ladite pluralité de capteurs de lignes (21-25) ; et
   des moyens de commande (65) destinés à déterminer, à partir des signaux de lignes respectifs, obtenus par lecture d'un élément de noir (16) de référence à l'aide de ladite pluralité de capteurs (21-25) de lignes, des différences de niveau en des points correspondant aux limites entre des capteurs de lignes (21-25), et, sur la base de ces différences, à commander lesdits moyens (75) de réglage de niveau pour appliquer un décalage de niveau respectif unique à chaque signal de ligne respectif afin d'aligner lesdits signaux de lignes en des points correspondants auxdites limites.

2. Appareil selon la revendication 1, comportant en outre des moyens de conversion (76) destinés à convertir des signaux provenant de ladite pluralité de moyens de réglage de niveau en signaux numériques.

3. Appareil selon la revendication 1, dans lequel chacun de ladite pluralité de capteurs de lignes est conçu pour lire une image en couleurs d'un document et est conçu pour générer plusieurs signaux de composantes de couleurs.

4. Appareil selon la revendication 1, dans lequel lesdits moyens de réglage comportent des moyens de mémorisation (65) destinés à mémoriser les signaux de lignes respectifs obtenus par lecture de l'élément noir de référence.

5. Appareil selon la revendication 1, comportant plusieurs moyens (74) de réglage de gain destinés à appliquer chacun une amplification à gain réglable respective au signal de ligne délivré en sortie par chacun, respectif, de ladite pluralité de capteurs de lignes.

6. Appareil selon la revendication 5, dans lequel ladite pluralité de moyens de réglage de gain est agencée pour effectuer un réglage de gain sur la base de signaux obtenus en lisant un élément de blanc de référence au moyen de ladite pluralité de capteurs de lignes.

7. Appareil selon la revendication 3, pour la lecture d'une image en couleurs, lequel appareil comporte :

un capteur (15) d'image comportant ladite pluralité de capteurs (21-25) de lignes, destinés chacun à délivrer en sortie un signal de ligne respectif pour une partie de ligne respective d'un élément de référence (16, 17) ou d'un document (121), comportant chacun un réseau linéaire d'éléments capteurs (D13-D36) protégés optiquement et des éléments capteurs de signaux effectifs (S1-S3072), ces derniers étant recouverts par un réseau de filtres de couleurs ayant une séquence récurrente de trois couleurs, lesdits capteurs de lignes étant agencés en quinconce en deux rangées de manière que lesdits éléments capteurs effectifs (S1-S3072) s'étendent sur la largeur de lecture dudit capteur d'image (15) sans discontinuité ni chevauchement ;
des circuits (61a-61e) de traitement de signaux analogiques, un pour chaque capteur de ligne (21-25), agencés chacun de façon à recevoir un signal de ligne respectif et ayant, pour chaque couleur, des moyens échantillonneurs-bloqueurs (72) destinés à séparer un signal de couleur respectif du signal de ligne respectif, des moyens (73-75) de décalage de niveau et de réglage de gain destinés à appliquer un décalage réglable de niveau de signal et une amplification à gain réglable au signal de couleur respectif, et un convertisseur analogique-numérique (76), d'une gamme dynamique prédéterminée, destiné à convertir le signal de couleur respective délivré en sortie par lesdits moyens (73-75) de décalage de niveau et de réglage de gain en données numériques ; et
des moyens de commande (62-65), en réponse auxdites données numériques, destinés à déterminer et à commander le décalage de niveau et le gain appliqués par lesdits moyens (73-75) de décalage de niveau et de réglage de gain ;

dans lequel
ledit appareil comprend un élément (16) de référence de noir et un élément (17) de référence de blanc et est conçu pour lire l'élément (16) de référence de noir, l'élément (17) de référence de blanc et le document (121), tour à tour ;
chacun des moyens (73-75) de décalage de niveau et de réglage de gain comprend :

i) des moyens de blocage (81, 84) qui, en réponse auxdits éléments capteurs (D13-D36) protégés optiquement, sont destinés à appliquer un décalage de niveau au signal de couleur respectif ;
ii) des moyens (82-85) de réglage de niveau qui, en réponse à des premières données de commande (D0-D7) fournies par lesdits moyens de commande (62-65), sont destinés à compléter le décalage de niveau appliqué par lesdits moyens de blocage (81, 84) ; et
iii) des moyens multiplicateurs (74) qui, en réponse à des secondes données de commande (DD0-DD7) fournies par lesdits moyens de commande (62-65), sont destinés à faire varier le gain du signal de couleurs respectives décalé par lesdits moyens de blocage (81, 84) et par lesdits moyens (82-85) de réglage de niveau ; et

lesdits moyens de commande (62-65) sont conçus pour exécuter une séquence d'étapes consistant :

(a) à déterminer, à partir de valeurs des données numériques, obtenues lors de la lecture dudit élément (16) de référence de noir avec lesdites premières et secondes données de commande (D0-D7, DD0-DD7) ayant des valeurs établies initiales, des différences de niveaux de signaux entre les signaux de couleurs respectifs, pour chaque couleur respective, en des points correspondant aux dernier et premier éléments capteurs effectifs (S3070,S1 ; S3071,S2 ; S3072,S3) de la couleur respective, définissant des limites respectives desdits capteurs de lignes (21-25), et fournissant des premières données de commande (D0-D7) d'une valeur modifiée auxdits moyens (82-85) de réglage de niveau, pour appliquer un décalage de niveau modifié à des signaux de couleurs respectifs afin d'égaliser les niveaux

des signaux auxdits points correspondants auxdites limites respectives ;
(b) à déterminer à partir des valeurs de données numériques, obtenues lors de la lecture dudit élément (16) de référence de noir avec lesdites premières et secondes données de commande (D0-D7, DD0-DD7) ayant ladite valeur modifiée et ladite valeur initiale, respectivement, une valeur minimale respective (D min) pour chaque couleur respective, et à appliquer des premières données de commande (D0-D7) de valeur révisée auxdits moyens (82-85) de réglage de niveau pour appliquer un décalage de niveau révisé à des signaux de couleurs respectifs afin qu'ils soient situés à ou au-dessus de la limite inférieure de la gamme dynamique des convertisseurs analogiques-numériques respectifs (76) ;
(c) à déterminer à partir de valeurs des données numériques, obtenues lors de la lecture dudit élément (17) de référence de blanc avec lesdites premières et secondes données de commande (D0-D7, DD0-DD7) ayant ladite valeur révisée et ladite valeur initiale, respectivement, des différences de niveau de signaux entre les signaux de couleurs respectifs, pour chaque couleur respective, auxdits points, et à fournir des secondes données de commande (DD0-DD7) d'une valeur modifiée auxdits moyens multiplicateurs (74), afin d'appliquer un gain modifié à des signaux de couleurs respectifs pour égaliser les niveaux des signaux correspondant auxdites limites respectives ;
(d) à déterminer à partir de valeurs des données numériques, obtenues lors de la lecture dudit élément (17) de référence de blanc avec lesdites premières et secondes données de commande (D0-D7, DD0-DD7) ayant lesdites valeurs révisées et lesdites valeurs modifiées, respectivement, une valeur maximale respective, pour chaque couleur respective, et à fournir des secondes données de commande respectives (DD0-DD7) d'une valeur révisée aux moyens multiplicateurs respectifs (74), afin d'appliquer un gain révisé à des signaux de couleurs respectives de manière qu'ils soient situés à ou au-dessous de la limite supérieure de la gamme dynamique des convertisseurs analogiques-numériques respectifs (76) ; et
(e) à fournir des premières et secondes données de commande respectives (D0-D7, DD0-DD7) desdites valeurs révisées aux moyens respectifs (75) de réglage de niveau et aux multiplicateurs respectifs (74) pour lire le document.

FIG. 1

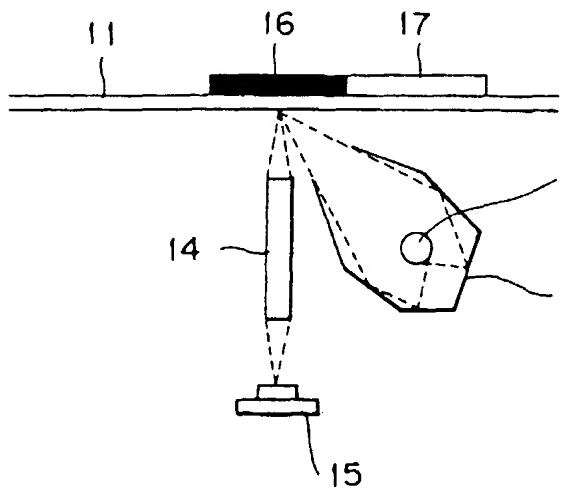


FIG. 2

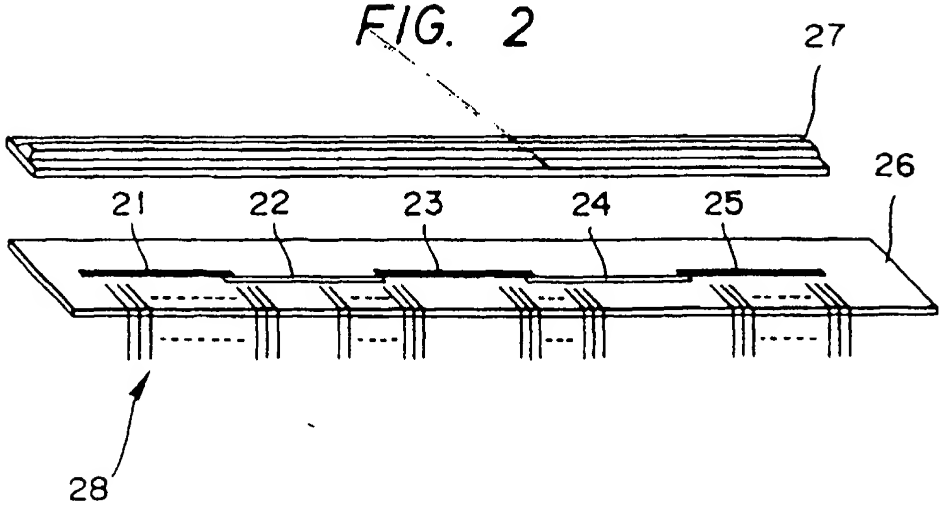


FIG. 3

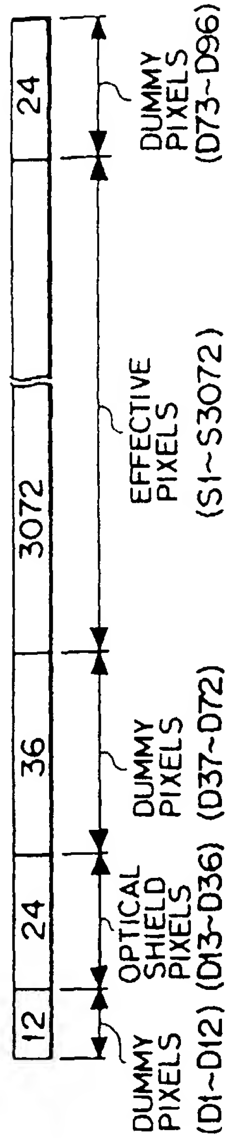

12
24
36
3072
24
DUMMY PIXELS (D1~D12)
OPTICAL SHIELD PIXELS (D13~D36)
DUMMY PIXELS (D37~D72)
EFFECTIVE PIXELS (S1~S3072)
DUMMY PIXELS (D73~D96)

FIG. 4

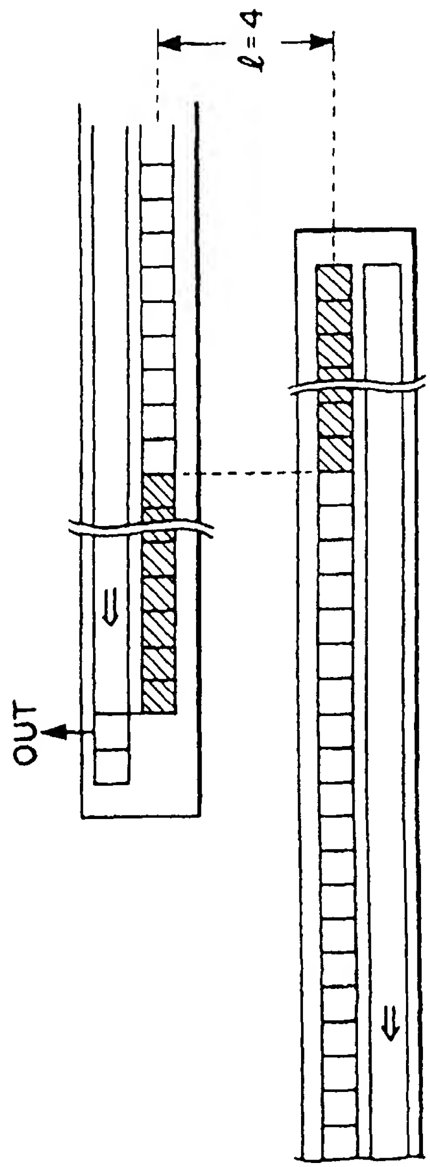

OUT
ℓ=4

FIG. 5

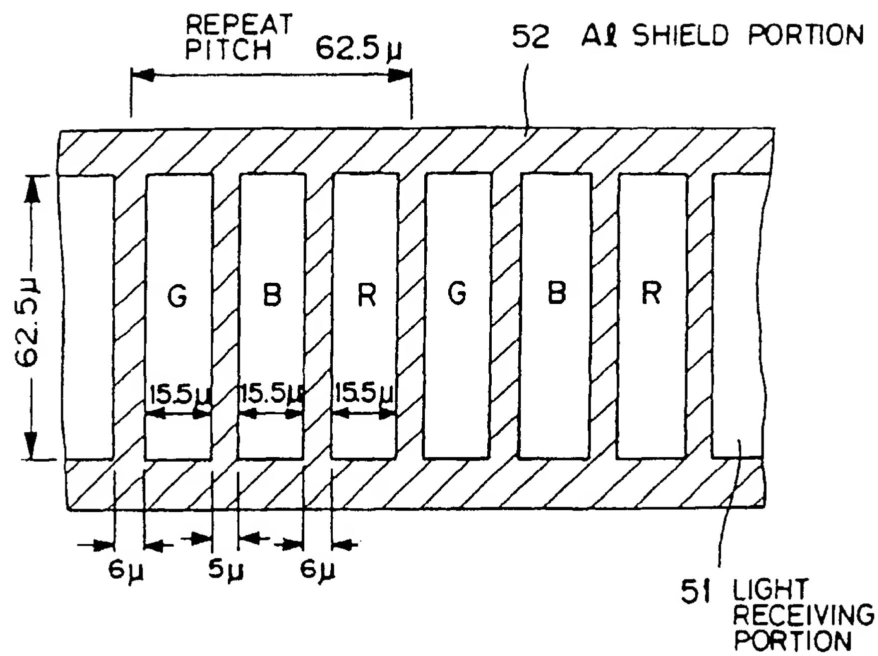
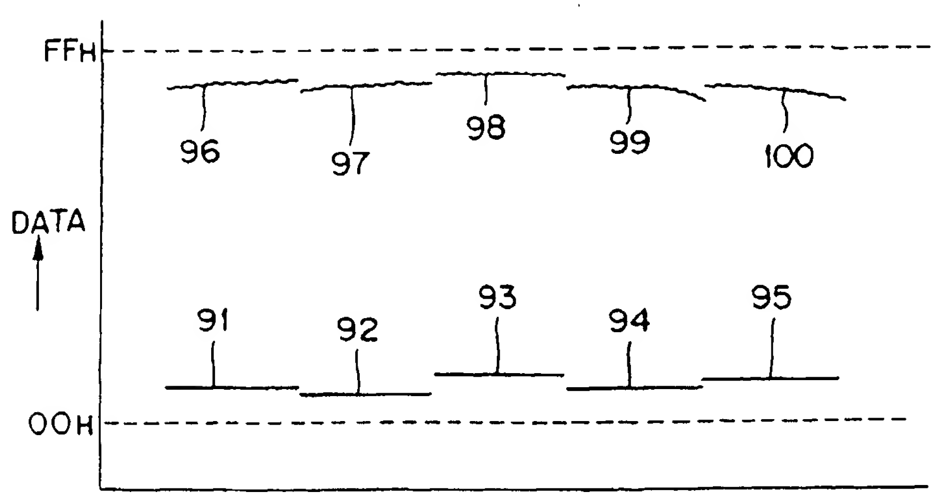

REPEAT PITCH 62.5μ
52 Aℓ SHIELD PORTION
62.5μ
G
B
R
G
B
R
15.5μ
15.5μ
15.5μ
6μ
5μ
6μ
51 LIGHT RECEIVING PORTION

FIG. 9


FFH
96
97
98
99
100
DATA
91
92
93
94
95
00H

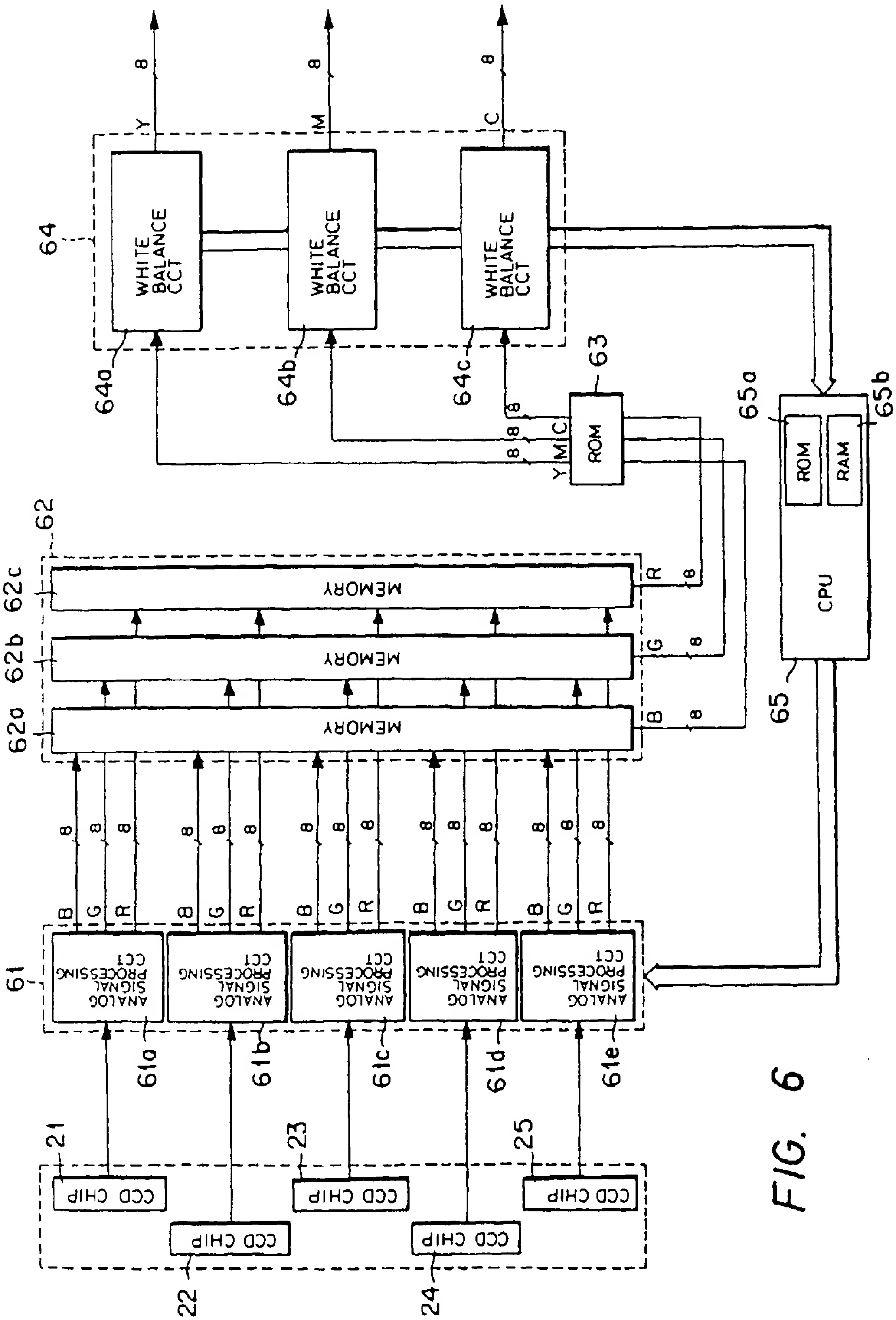

WHITE BALANCE CCT
MEMORY
ROM
RAM
CPU
CCD CHIP
ANALOG SIGNAL PROCESSING CCT

FIG. 6

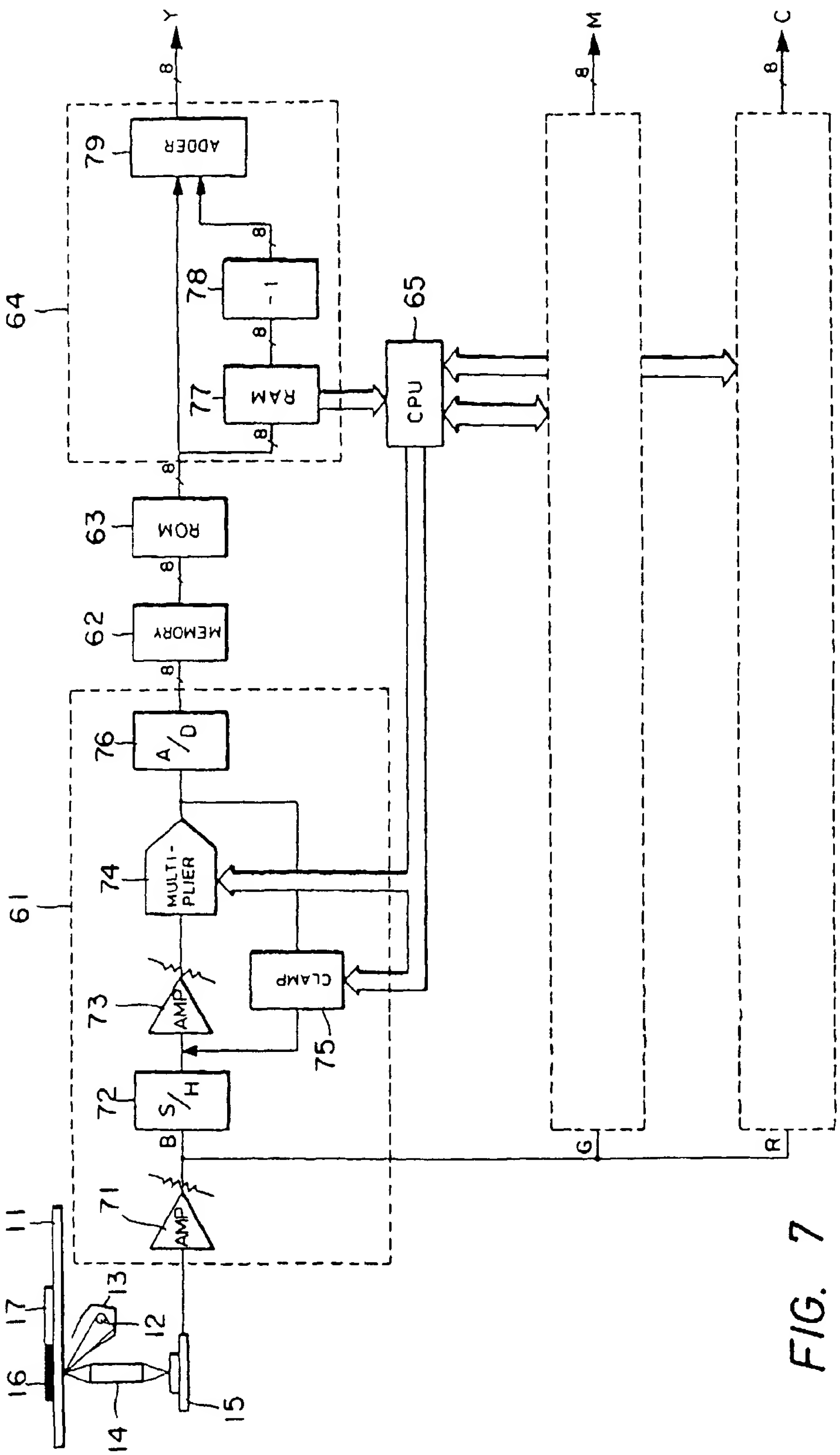

ADDER
RAM
-1
CPU
ROM
MEMORY
A/D
MULTI-PLIER
CLAMP
AMP
S/H
AMP
Y
M
C
B
G
R
8
11
12
13
14
15
16
17
61
62
63
64
65
71
72
73
74
75
76
77
78
79

FIG. 7

FIG. 8

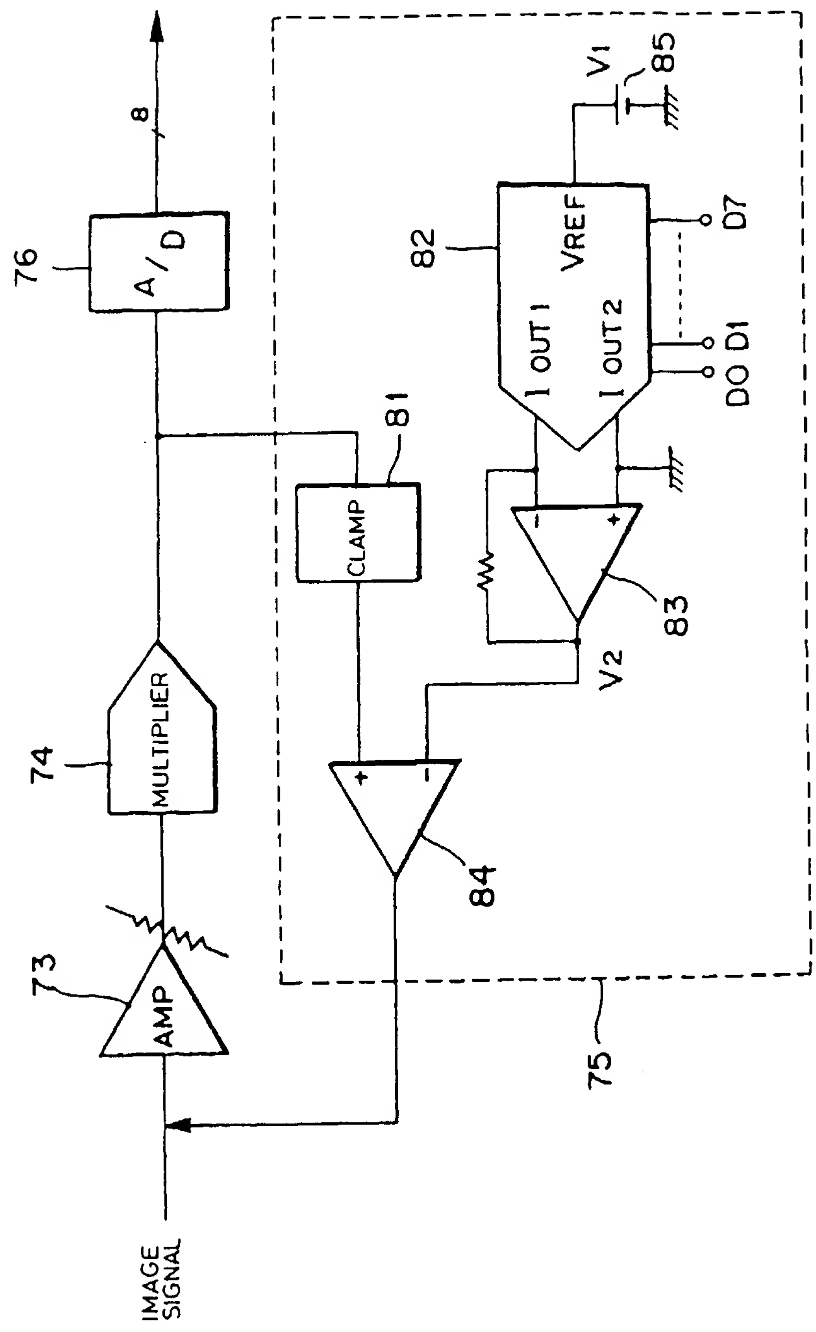


IMAGE SIGNAL
AMP
73
MULTIPLIER
74
A/D
76
8
CLAMP
81
82
I OUT 1
I OUT 2
VREF
V1
85
D7
D0 D1
83
V2
84
75

FIG. 10

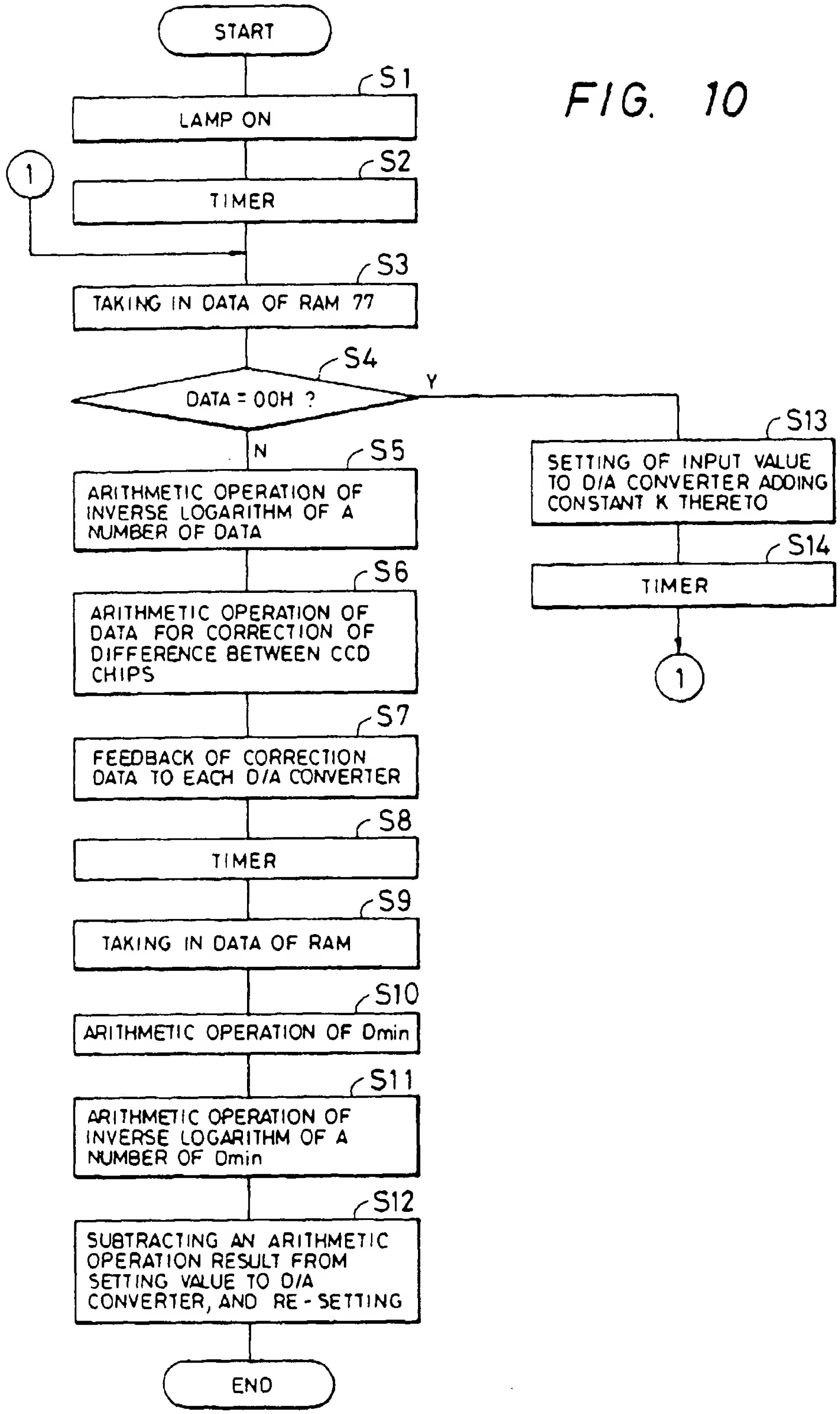

START
S1
LAMP ON
S2
TIMER
1
S3
TAKING IN DATA OF RAM 77
S4
DATA = 00H ?
Y
N
S5
ARITHMETIC OPERATION OF INVERSE LOGARITHM OF A NUMBER OF DATA
S6
ARITHMETIC OPERATION OF DATA FOR CORRECTION OF DIFFERENCE BETWEEN CCD CHIPS
S7
FEEDBACK OF CORRECTION DATA TO EACH D/A CONVERTER
S8
TIMER
S9
TAKING IN DATA OF RAM
S10
ARITHMETIC OPERATION OF Dmin
S11
ARITHMETIC OPERATION OF INVERSE LOGARITHM OF A NUMBER OF Dmin
S12
SUBTRACTING AN ARITHMETIC OPERATION RESULT FROM SETTING VALUE TO D/A CONVERTER, AND RE-SETTING
END
S13
SETTING OF INPUT VALUE TO D/A CONVERTER ADDING CONSTANT K THERETO
S14
TIMER
1

FIG. 11

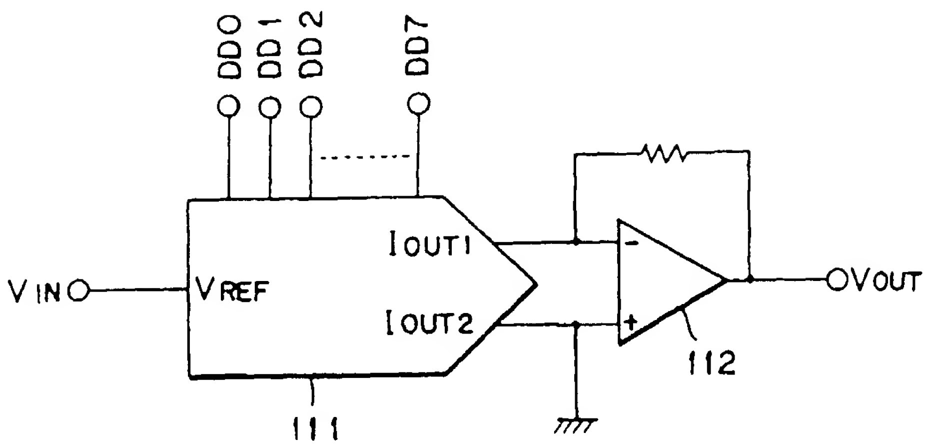
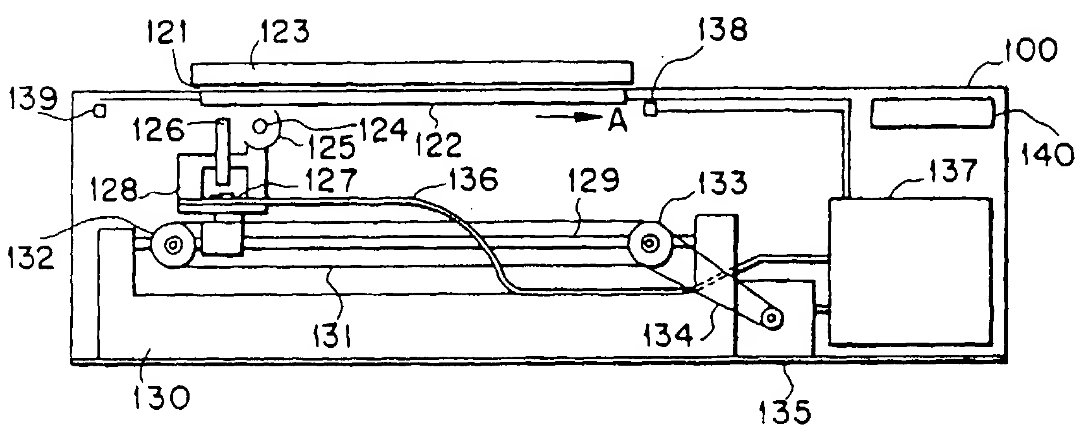

DD0
DD1
DD2
DD7
VIN
VREF
IOUT1
IOUT2
VOUT
111
112

FIG. 12


121
123
138
100
139
126
124
125
122
A
140
128
127
136
129
133
137
132
131
134
130
135